

Wastewater disinfection can be used to reduce the possibility of pathogenic organisms entering the environment. The most common types of onsite disinfection units use chlorine tablets, ultraviolet radiation, and ozone gas. Depending on the pretreatment process, disinfection may be required for some reuse systems such as drip irrigation.

It should be noted that many of the wastewater treatment systems outlined in other chapters of this report also provide disinfection. However, the systems described in the following discussion are differentiated from other systems because they attempt to provide reliable and predictable disinfection as their primary function.

### **10-1 Chlorination**

Category	Disinfection
Technology	Tablet chlorinator
Input	Secondary treated water
Function	Pathogen reduction/removal
Applications	Single home and small community residential systems

#### **Background**

For small onsite wastewater treatment systems, the most common type of disinfection equipment is the tablet chlorinator. The tablet chlorinator is the most common disinfection system because it does not require electricity, is easy to operate and maintain, and is relatively inexpensive.

#### **Description of process**

The tablet chlorinator consists of the following components:

- > A pretreatment system (e.g., primary and secondary treatment)
- > Chlorine tablets specially designed for this application (typically calcium hypochlorite, tablets designed for swimming pools and other applications may not be appropriate)
- > A reservoir for the chlorine tablets
- > An access cap for refilling the chlorine tablet reservoir
- > A device for contacting the chlorine tablets with the wastewater
- > A basin for providing sufficient contact time between the chlorine and the wastewater

In the tablet chlorination system, a solid chlorine tablet (specifically designed for this application) is partially submerged in the wastewater flow. As the water to be treated flows through the chlorination device, the chlorine tablet slowly dissolves and releases chlorine into the water. As the chlorine tablet dissolves, another chlorine tablet slides down into the wastewater flow.

Chlorinated water may inhibit the performance of subsequent soil treatment systems. In some cases, chlorination has been used to inhibit biological growth in trickling filter systems. In areas where water is distributed for irrigation, chlorine is used to ensure the prevention of disease transmission through wastewater.

#### **System footprint**

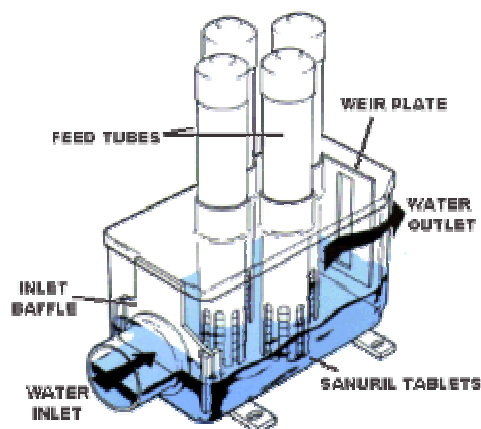
Typical surface area of a tablet chlorination system is about 2 to 4 ft<sup>2</sup>. Tablet chlorination systems are usually located at grade following a secondary treatment process. A chlorine contact tank will also require 2 to 4 ft<sup>2</sup>.

#### **Advantages**

Units are inexpensive and do not require energy to operate. Easy to operate and maintain.

### Disadvantages

Require periodic chemical addition. Chlorine tablet feeder may jam and cause system to not work properly. Requires the handling of chemicals.



**Fig 10-1**

Device for contacting chlorine tablets with treated wastewater. (Adapted from Severn Trent De Nora.)

### Performance

When applied correctly, chlorination is an effective method to control disease causing organisms in wastewater. Sufficient contact time and the presence of chlorine residual can ensure that the system performs as stated in manufacturer claims. Chlorinated water must be collected in a holding (chlorine contact) tank to provide sufficient holding time to accomplish disinfection, typically 20 to 40 minutes. Water may also require dechlorination depending on characteristics of receiving area.

### Operation and maintenance

For this system, the operational parameters include the rate at which the chlorine tablets dissolve, the amount of chlorine transferred into solution, the capacity of the chlorine tablet reservoir, and the time required between servicing. Systems should be inspected monthly to ensure operation. For a typical system, tablets may need to be added every 4 to 6 months.

### Power and control

None needed.

### Cost

Tablet chlorinators for individual homes can range from \$250 to 300. Annual operation chemical costs can range from \$200 to 300. If a dechlorination system is also used the cost will be about double.

### References and other resources

Texas Agricultural Extension Service (2000) Tablet Chlorination; <http://texaserc.tamu.edu>

#### **10-1.1 American Manufacturing Company, Inc.**

PO Box 549

Manassas, VA 20108-0549

Phone (800) 345-3132

Fax (703) 754-0058

Web [www.americanonsite.com](http://www.americanonsite.com)

**10-1.2 Hammonds**

15760 West Hardy Road, Suite 400  
 Houston, TX 77060  
 Phone (281) 999-2900  
 Fax (281) 847-1857  
 Web www.hammondscos.com

**10-1.3 JET, Inc.**

750 Alpha Dr.  
 Cleveland OH 44143  
 Phone (440) 461-2000  
 Fax (440) 442-9008  
 Web www.jetincorp.com  
 Model description  
 Jet Inc. offers the JET-CHLOR systems

**10-1.4 Norweco**

Norwalk Wastewater Equipment Company, Inc.  
 220 Republic Street  
 Norwalk OH 44857-1196  
 Phone (419) 668-4471  
 Fax (419) 663-5440  
 Model description  
 Norweco manufactures the Bio-dynamic chlorination and dechlorination systems for flow rates in the range of 200 to 200,000 gpd. Norweco also provides aerated wastewater treatment, flow equalization, and effluent filtration.

**10-1.5 Sanuril**

Severn Trent De Nora  
 1110 Industrial Blvd  
 Sugar Land, TX 77478  
 Phone (281) 240-6770  
 Fax (281) 670-6762  
 E customer\_service@severntrentdenora.com  
 Web www.severntrentdenora.com

**10-2 Ozonation**

Category	Disinfection
Technology	Ozone
Input	Secondary treated water
Function	Pathogen reduction/removal
Applications	Community, industrial, municipal, and commercial systems

**Background**

Ozone is a strong oxidant that has been used for the disinfection of water and wastewater. Because ozone is not chemically stable, it must be generated onsite near the point of use, making the system more complex than tablet chlorinators. Ozone has also been used in combination with other compounds for advanced oxidation treatment of wastewater. Ozone is used primarily for medium and large treatment facilities; however, ozone disinfection may become feasible for small systems in the future.

**Description of process**

The ozonation process is composed of several steps, including the generation of ozone gas, the

transfer of ozone gas into the water to be treated, and the mixing and contact between ozone and the water to obtain treatment results. The components of the ozone disinfection system are as follows (Aqua-flo Inc., Baltimore, MD):

- > Ozone generator to produce sufficient ozone from air or oxygen feed source
- > Air dryer or oxygen feed gas source (oxygen generators require compressed air)
- > Ozone delivery line and check valve for transport of ozone gas
- > Venture injector or diffusion stone to distribute ozone into water
- > Mixing and contact tank to provide adequate contact time between ozone and water
- > Pump to push water through venture injector or to push ozone through diffusion stone
- > Flow gauges and pressure gauges for process monitoring

### **System footprint**

For larger scale applications, systems are relatively small when compared to other disinfection technologies.

### **Advantages**

Very effective disinfectant, especially for resistant organisms such as viruses. Increases amount of dissolved oxygen in water. Disinfectant is generated onsite. No residual effect.

### **Disadvantages**

High operation and maintenance costs. Relatively expensive. No residual effect.

### **Performance**

The process performance depends on factors such as the ozone concentration and contact time, the characteristics of the water to be treated, and the characteristics of the organisms to be destroyed. Under normal operating conditions, for high quality effluents, ozone can be an effective disinfection method.

### **Operation and maintenance**

Ozonation systems require regular monitoring due to the relative complexity of the system. Important monitoring points include the concentration of ozone in the water, checking for system leaks, and testing and calibration of electrical components. Electrical and mechanical components will need to be serviced as recommended by the manufacturer. If water is to be reused for fixtures, it will be necessary to account for the precipitation of iron due to oxidation during ozonation treatment.

### **Suppliers / Patents**

In addition to the manufacturers listed below, many pool and spa companies sell reasonably prices ozonation equipment that may be adaptable to the disinfection of treated wastewater.

#### **10-2.1 Aqua-flo Inc.**

6244 Frankford Ave

Baltimore, MD 21206

Phone (800) 368-2513

Fax (410) 488-2030

E [aquaflo@erols.com](mailto:aquaflo@erols.com)

Web [www.aquafloinc.com](http://www.aquafloinc.com)

Model description

Manufactures ozonation equipment for various domestic, commercial, and industrial applications, including water and wastewater disinfection and treatment, odor control, and air treatment.

**10-2.2 Ozonia**

P.O. Box 455  
 491 Edward H. Ross Drive  
 Elmwood Park, NJ 07407  
 Phone (201) 794-3100  
 Fax (201) 794-3358  
 Web www.ozonia.com

**Model description**

Manufactures advanced ozone and UV treatment process. Applications include water and wastewater treatment as well as commercial and industrial uses.

**10-2.3 RGF Environmental**

3875 Fiscal Court  
 West Palm Beach, FL 33404  
 Phone (800) 842-7771  
 Fax (888) 848-0047  
 Web www.rgf.com

**Model description**

Manufactures complete line of wastewater products including ozonation systems and aerobic treatment systems.

**References and other resources**

Gross MA and SW Jones (1999) Stratified Sand Filter and Ozonation for Wastewater Reuse, in *Proceedings NOWRA Conference*, 8<sup>th</sup> Annual Conference and Exhibit, Jekyll Island, GA.

Townshend AR, EC Jowett, RA LeCraw, DH Walter, R Paloheimo, C Ives, P Russell, and M Liefhebber (1997) Potable Water Treatment and Reuse of Domestic Wastewater in the CMHC Toronto Healthy House, *Site Characterization and Design of Onsite Septic Systems*, ASTM STP 1324, MS Bedinger, JS Fleming, and AI Johnson, American Society for Testing and Materials, West Conshohocken, PA.

U.S. EPA (1999) Wastewater Technology Fact Sheet: Ozone Fact Sheet.

**10-3 Ultraviolet radiation (UV)**

Category	Disinfection
Technology	Ultraviolet radiation
Input	Secondary treated water
Function	Pathogen reduction/removal
Applications	Individual, community, commercial, industrial, and municipal wastewater systems

**Background**

Ultraviolet light is an effective disinfectant for water and wastewater. For small systems, UV light has been used most commonly as a disinfectant before wastewater reuse for irrigation. This technology is widely available and well characterized.

**Description of process**

A common configuration of a UV disinfection system is composed of one or more lamps that are encased in a quartz sleeve and submerged in a tubular reactor. Water to be treated enters one end of the reactor and is exposed to the UV radiation for a required amount of time. After sufficient exposure, the water exits the system and is discharged. In some applications the water is recirculated through the UV system to improve overall removal.



**Fig 10-2**

A sand filter pump control and alarm system and ultraviolet disinfection system (steel cylinder to the right of the control box) used to treat sand filter effluent before landscape irrigation.

### **System footprint**

Systems are relatively small, occupying several square feet for an individual or cluster system.

### **Advantages**

An effective disinfectant. Does not leave residual chemical or toxicity in the water. Not space intensive.

### **Disadvantages**

No residual effect. Capital and maintenance (lamp replacement) costs may be relatively high.

### **Performance**

The effectiveness of UV systems is highly dependent on the quality of the water to be treated. Because of the ability of wastewater particles to absorb the UV radiation that would otherwise be used for organism inactivation, lower levels of turbidity and suspended solids in the water results in improved treatment. UV disinfection systems do not leave a residual in the water and do not require additional tankage to accomplish contact time as with chlorine and ozone.

### **Operation and maintenance**

UV disinfection systems require that the lamps be cleaned and/or changed periodically to maintain a high level of treatment. Because the system uses electrical power it will need regular inspection to ensure correct operation.

### **Power and control**

Annual power requirements can range from 200 to 400 kWh.

### **Cost**

Single bulb disinfection units (for the disinfection of wastewater from an individual residence) cost in the range of \$750 to 1000. Replacement bulbs cost about \$100 per year.

#### **10-3.1 International Water-Guard Industries Inc.**

3133 Sumner Ave.  
Burnaby, BC, Canada, V5G 3E3  
Phone (604) 255-5555  
Fax (604) 255-5685  
[www.waterknowledge.com](http://www.waterknowledge.com)

**10-3.2 Ozonia**

P.O. Box 455  
 491 Edward H. Ross Drive  
 Elmwood Park, NJ 07407  
 Phone (201) 794-3100  
 Fax (201) 794-3358  
 Web [www.ozonia.com](http://www.ozonia.com)

**Model description**

Manufactures advanced ozone and UV treatment process. Applications include water and wastewater treatment as well as commercial and industrial uses.

**10-3.3 Salcor Engineering**

P.O. Box 1090  
 Fallbrook, CA 92088-1090  
 Phone (760) 731-0745  
 Fax (760) 731-2405  
 E [jscruver@aol.com](mailto:jscruver@aol.com)

**Model description**

Manufactures UV disinfection systems for small wastewater treatment systems. Systems have performed well even under conditions of high suspended particles in the water.

**10-3.4 Trojan Technologies, Inc.**

1380 East Vocell Blvd., Suite B  
 Davis, CA 95616  
 Phone (530) 759-7600  
 Fax (530) 759-7620  
 E [trojanca@trojanuv.com](mailto:trojanca@trojanuv.com)  
 Web [www.trojanuv.com](http://www.trojanuv.com)

**References and other resources**

U.S. EPA (1999) Wastewater Technology Fact Sheet: Ultraviolet Disinfection Fact Sheet. EPA-832/F/99/064.

**10-4 Peracetic Acid**

Category	Disinfection
Technology	Chemical disinfectant
Input	Secondary treated water
Function	Pathogen reduction/removal
Applications	Individual, community, commercial, industrial, municipal

**Background**

Peracetic acid based disinfectants have been developed for the control of pathogenic microorganisms in sewage effluent and sludge. Solvay Interlox manufactures an equilibrium mixture of peracetic acid, hydrogen peroxide, acetic acid and water. In surface water peracetic acid will be hydrolysed. The degradation products formed by hydrolysis are acetic acid and hydrogen peroxide, both of which are easily biodegradable substances.

During the field trials it was found that, within the application concentrations required for disinfection, peracetic acid also reduced sludge odor. In addition, peracetic acid was rapidly utilized in the sludge and gave rise to safe, readily biodegradable, non-toxic decomposition products. At optimum concentrations required for disinfection of sludge, these trials proved peracetic acid was not harmful to pasture plants, invertebrates, or to the beneficial organisms

occurring in the soil. The fertilizer and soil conditioning values of the sludge were undiminished. Peracetic acid was also found to be effective against *E. coli*.

**Advantages**

- > Effective against a broad spectrum of microorganisms
- > Operates over a wide temperature range
- > Controls odors
- > Removes sulfides
- > Non-foaming
- > No toxic residues
- > Safe decomposition products
- > No disposal problems
- > Easy to use
- > Limited investment cost

**Disadvantages**

- > Difficult to obtain
- > Very expensive relative to other disinfectants

**10-4.1 Solvay Interlox**

3333 Richmond Avenue  
Houston, TX 77098-3099  
Phone (800) INT-EROX; (713) 525-6500  
Fax (713) 524-9032  
Web [www.solvay.com](http://www.solvay.com)